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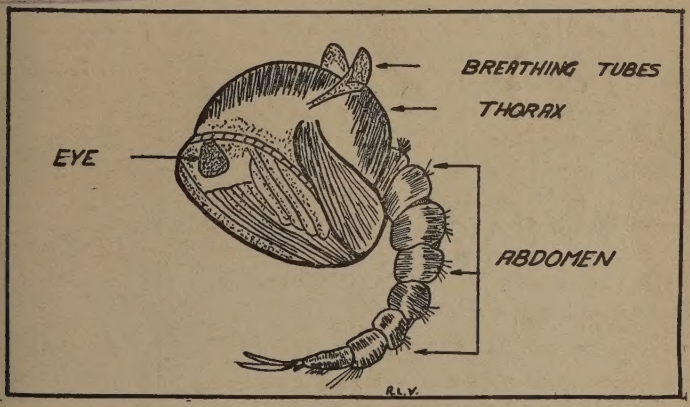

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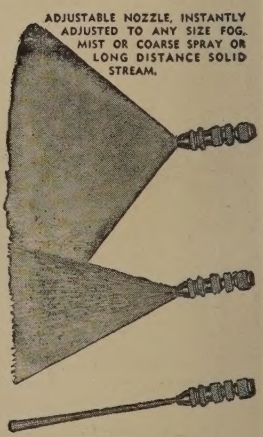

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MALARIA CONTROL IN THE TENNESSEE VALLEY

By A. D. Hess* and C. C. Kiker*

INTRODUCTION

During the past ten years the Tennessee Valley Authority has transformed the Tennessee River and its tributaries into a vast series of man-made lakes. With the impounding of the Kentucky and Fontana Reservoirs during the coming season, the Authority will have in operation nine main river and fourteen storage reservoirs. In addition, several privately-owned reservoirs are operated in the system. With the completion of the construction program, the reservoirs will have a total water surface of some 735,000 acres and over 10,000 miles of shoreline. Although the major portion of the Tennessee River drainage system lies within the states of Tennessee and Alabama, five other states are also involved, namely, Kentucky, Virginia, North Carolina, Georgia, and Mississippi.

Experience over a period of years has proved that whenever water is impounded in the Southeastern United States favorable conditions are created for the production of **Anopheles quadrimaculatus**, the only important vector of malaria in this region. Failure to take this fact into consideration and to provide adequate control measures has frequently resulted in serious malaria transmission. In order to prevent such occurrences, the Authority carries out a carefully planned pre- and post-impoundage program of malaria control on each of its reservoirs. The program on each reservoir is developed independently with reference to the specific problems involved and in accordance with the regulations of the health department of the state in which the reservoir is impounded.

The technical planning, supervision, and appraisal of the program is carried out by a malaria control team consisting of a malariologist (M.D.), a biologist, and an engineer. This malaria control team is assisted in its planning and appraisal by a board of malaria consultants which includes the country's leading authorities on malaria control. Application of the program on the individual reservoirs is under the direction of resident sanitary engineers. Information for use in improving the economy and effectiveness of the program is also obtained through the efforts of a research staff which includes engineers, entomologists, parasitologists, botanists, limnologists, toxicologists, and epidemiologists. The research program includes investigations on the chemotherapeutics of malaria and on the biology and control of malaria mosquitoes and the littoral plants with which their production is associated. Of particular importance at the present time are investigations on the water level relationships of marginal plants, new methods and materials for use in adult spraying and larvicidal control, and development of more effective antimalarial drugs.

The malaria control program starts with the construction of the reservoir. The main phases of the program are reservoir preparation, permanent shoreline improvements, shoreline maintenance, water level management, and the application of larvicides. These phases are discussed individually in the following paragraphs.

RESERVOIR PREPARATION

The principal elements of reservoir preparation are reservoir clearance, marginal drainage, final reconditioning of the zone of fluctuation, and wintertime impoundage. Reservoir clearance (See Fig. 1) is not only a necessary antilarval measure, but may also be a requisite for removal of hazards to

*Biologist and Sanitary Engineer, Health and Safety Department, Tennessee Valley Authority, Wilson Dam, Ala. Submitted March 18, 1944.

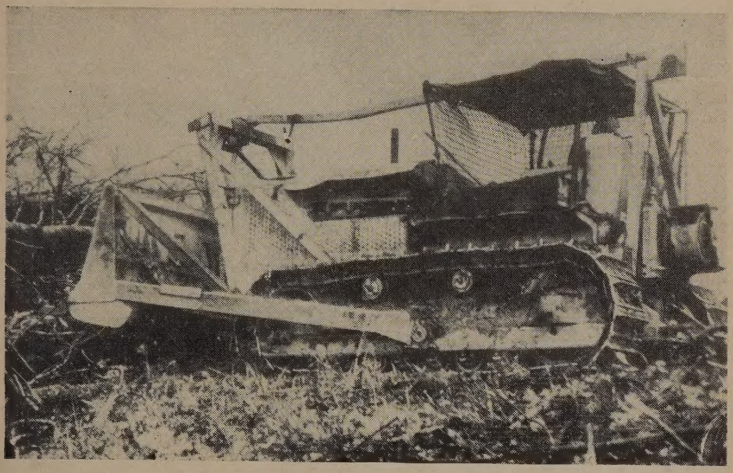
navigation and sources of objectionable drift which would accumulate at the dam. Reservoir clearance for malaria control is carried out in accordance with detailed specifications developed by the Authority and approved by the state health department. In addition to providing for the general clearing up to the normal maximum summertime water elevation, these specifications provide for certain special types of clearing, such as erosion clearing, clearing at heads of bights and indentations, clearing for airplane dusting, and selective clearing in the flood surcharge zone.

Marginal drainage is an important element of reservoir preparation. Limesinks and other depressions located between maximum and minimum elevations are connected with the main reservoir by means of drainage ditches (See Fig. 2). This ensures that these marginal depressions may be subjected to the same water level management used on the main reservoir and also makes them accessible by boat for carrying out larvicidal and shoreline conditioning operations.

A relatively recent development in reservoir preparation has been the carrying out of a final reconditioning operation in the zone of fluctuation just prior to impoundage. On some of the larger reservoirs several years may be required to complete the reservoir clearance operations. As a result, there is considerable growth of coppice in the cleared fluctuation zone before

A. Ordinary reservoir clearance operations involve felling, limbing, topping, cutting, and separate piling and burning of logs and brush.

the time of impoundage. If not removed, this coppice will catch drift and flotage and create favorable conditions for the production of **Anopheles quadrimaculatus** during the initial season of impoundage; also, the woody tolerant species will continue to live and grow if they have attained sufficient height to be emergent. It has, therefore, proved highly desirable to thoroughly recondition the zone of fluctuation in the fall just prior to impoundage in order that the maximum of clean water surface may be obtained.



B. The use of the power rake has greatly decreased the cost of reservoir clearance. It eliminates the need for limbing, topping, cutting, and hand piling.

Fig. 1. Reservoir Clearance for Malaria Control.

It has been repeatedly demonstrated that the impoundage of a new reservoir during the summer creates ideal breeding conditions for **Anopheles quadrimaculatus** and may result in serious malaria transmission. The Authority, therefore, recommends that the initial impoundage be made during the winter months. During the last two years, the increased need for power in connection with the war effort has made it necessary to impound several reservoirs during the summer months. This was done without serious malaria transmission because of the application of emergency control measures, including special shoreline conditioning, oiling, airplane dusting, and water level management.

A detailed discussion of reservoir preparation will be found in the publications of Kiker and Stromquist (1939) and Hinman (1941).

SHORELINE MAINTENANCE

Following the impoundage of a reservoir, a program of shoreline maintenance is carried out. The principal elements of this shoreline maintenance program are annual shoreline conditioning, aquatic growth control, marginal grazing, and drainage maintenance.

The annual shoreline conditioning program provides for the removal of annual growth from the zone of fluctuation (See Fig. 3). Chief emphasis is placed upon the removal of coppice of water tolerant woody species, such as willow and buttonball, and the removal of stiff-stemmed annuals, such as giant ragweed. The production of coppice by water tolerant species, such as willow, may be effectively prevented by flush cutting the stumps and treating them with an herbicidal oil. The removal of small coppice and annual growth is carried out by means of area burning, horse- and power-driven mowers, and hand rebrushing. The maximum use of mowing and area burning decreases the cost of the operation.

Aquatic growth control operations are carried out against truly aquatic species, such as lotus (**Nelumbo lutea**) and cowlily (**Nympheae advena**). These species have been controlled successfully by recurrent cuttings with a Hockney type underwater weed-cutter (See Fig. 4). Successful control of marginal aquatics, such as alligator weed (**Achyranthes philoxeroides**), has been achieved through the application of herbicidal oils.

Marginal grazing has proved to be a very effective biological means of controlling the growth in the zone of fluctuation (See Fig. 5). The use of such shoreline grazing, therefore, is recommended wherever it fits into the over-all land use program. The benefits of this measure may be increased through the use of contour fencing and grazing rotation.

An annual maintenance of marginal drainage ditches is carried out in order to ensure their continued function. In the upper end of the Valley, such drainage maintenance usually consists in removing trees, trash, or other debris which has fallen into the ditches and might obstruct the passage of water through them. In certain sections in the lower end of the Valley

Fig. 2. Marginal drainage provides boat access to lateral depressions and makes it possible to regulate the water levels with those of the main reservoir. The above view shows a small limesink connected to the main body of a storage reservoir by means of a dragline ditch.

where the soil is sandy, there is also a considerable maintenance problem due to the silting-in of the drainage ditches.

Shoreline maintenance has been discussed in more detail by Hinman (1941).

PERMANENT SHORELINE IMPROVEMENT

During recent years the Authority has initiated the use of measures to eliminate permanently the need for antilarval operations. These permanent

Fig. 3. Shoreline conditioning limits the production of **Anopheles quadrimaculatus** by providing a maximum of clean water surface. In the above view the area to the right was conditioned and that to the left was not.

improvement measures include diking and dewatering, cutting and filling, and land use restriction to daytime occupancy. Such permanent works for the control of **Anopheles quadrimaculatus** have been developed as a pre-impoundage operation in Kentucky Reservoir, which is to be impounded during the 1944 season, and involve some 14,000 acres or 70 per cent of the 20,000 acres of potential mosquito breeding surface around the margin of this reservoir. In other reservoirs, permanent improvement is being developed as a post-impoundage measure.

Diking and dewatering (See Fig. 6) is a particularly effective means of permanently eliminating the production of **A. quadrimaculatus.** The areas to be controlled are diked off and equipped with a system of drainage ditches and pumping units for removing the run-off. During the mosquito breeding season the areas are kept dewatered, thus preventing mosquito production. In many instances, it is possible to decrease greatly the malaria control cost allocation by utilizing the dikes as fills in the relocation of highways and railroads. Frequently, valuable land is retained for agricultural use through the application of this measure. In some instances, the areas are reflooded in the fall to provide resting and feeding grounds for migrating waterfowl and thus benefit the Authority's wildlife conservation program.

In smaller problem areas, it is frequently possible to use filling as a means of permanently removing the mosquito production hazard. The economy of this operation is benefited through the use of a combined cutting and filling operation which deepens part of the area and fills the remaining above the elevation of the normal maximum summertime water level.

In areas having a sparse population and limited agricultural use, it has

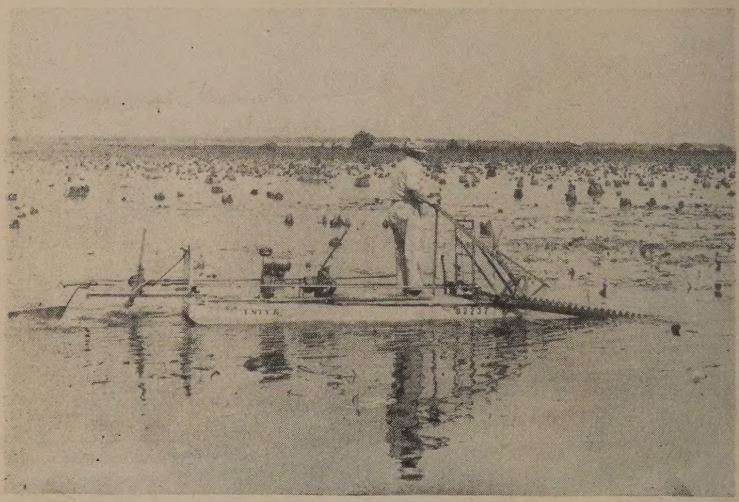


Fig. 4. Special aquatic growth control measures are directed at those species which extend the breeding areas out into the deeper waters. In the above view an underwater weed-cutter is being used to control cowlily (**Nymphaea advena**) by recurrent cutting.

been possible to prevent effectively malaria transmission through the restriction of land use to daytime occupancy. In the application of this measure, all dwellings are removed from the one mile zone, and occupation of the area during the mosquito breeding season is permitted only during the day time. Since **A. quadrimaculatus** bites only at night, malaria transmission is prevented by keeping people out of the area at night.

A more detailed discussion of permanent works for the control of anophelines on impounded waters has been given by Bishop and Gartrell (1943) in a paper presented at the recent meetings of the National Malaria Society.

HOUSE MOSQUITO-PROOFING

In certain situations it is possible to make effective use of house mosquito-proofing (See Fig. 7) as a secondary means of providing essential protection from malaria transmission. Where house mosquito-proofing is supported by shoreline conditioning and water level management, it is sometimes possible to substitute it for the more expensive, and often ineffective, larvicidal control. Effective reduction of malaria transmission through the use of mosquito-proofing has been brought about under the conditions of low malaria prevalence which have occurred during recent years, but it is desirable also to thoroughly test this measure under condition of epidemic malaria transmission. Recent information on mosquito-proofing for malaria control has been presented by Kiker (1941), Watson and Maher (1941), and Watson and Rice (1941).

Fig. 5. Grazing is an effective biological means of marginal growth removal. The area to the right in the above picture was grazed while that to the left was not.

WATER LEVEL MANAGEMENT

Of all malaria control measures used by the Authority, none is more important than water level management. It is the backbone of the malaria control program and is the dominant factor in determining the effectiveness and economy of each season's operations. In developing water level management for malaria control on the Authority's reservoirs, it has been necessary to fit the schedule into the multipurpose use of the reservoirs, namely, flood control, navigation, and the generation of power. The water level management schedule now in use on most of the main river reservoirs of the Authority consists of four phases, each with a particular function (See Fig. 8). These phases are: (1) An early spring flood surcharge; (2) The maintenance of a relatively constant pool level; (3) The use of cyclical fluctuation without recession; and (4) The combined use of cyclical fluctuation and seasonal recession.

In the application of the flood surcharge phase, the water elevation is brought up into the flood surcharge zone for a brief period during the late winter or early spring. The water is then brought down to the normal maximum summertime pool elevation, thus stranding the winter's accumulation of drift and flotage. This helps to create clean water conditions at the beginning of the breeding season.

During the spring growth period, the water is held at a relatively constant level at the normal maximum summertime elevation. This prevents the invasion of marginal vegetation and thus provides for a clean shoreline during the period of maximum mosquito production; by narrowing the band of growth invasion, it also decreases the amount of growth removal necessary in the annual fall shoreline conditioning operation. The application of this measure is made possible by the fact that most of the marginal species

Fig. 6. Diking and dewatering is an effective means of permanent shoreline improvement. The above photograph shows the construction of a dike in the Duck River area of Kentucky Reservoir.

which are a problem in the Authority's reservoirs will not germinate or initiate growth until they are dewatered.

With the beginning of moderate mosquito production, the use of cyclical fluctuation without recession is initiated (See Fig. 9). In the application of this measure, the water elevation is lowered approximately one foot and then returned to the original level over a period of a week or ten days. At the bottom of the cycle, the water is brought down out of the marginal band of vegetation giving a clean shoreline. This appears to limit the production of **A. quadrimaculatus** in a number of ways, including the stranding of eggs and larvae, the creating of less favorable conditions for oviposition, and the exposing of larvae to natural enemies, such as **Gambusia.**

The use of a combined schedule of cyclical fluctuation and seasonal recession is initiated with the beginning of heavy production of **A. quadrimaculatus.** In the application of this measure, the water level is brought down a foot but returned only nine-tenths of a foot, thus giving a seasonal recession of about one-tenth of a foot a week. This seasonal recession serves to keep ahead of the gradual invasion of marginal vegetation and ensures that the water level will be brought out of the vegetation into a clean shoreline at the bottom of each weekly cycle. With the extended use of the constant pool level phase, it has been possible to limit the amount of seasonal recession, and, in general, two feet of seasonal recession or three feet over-all recession has proved adequate.

On one of the main river reservoirs (Lake Wilson), which has a high generating capacity and a low storage capacity, satisfactory mosquito control has been achieved through the use of weekly cyclical fluctuations of about two feet without seasonal recession. The high generating capacity installed in this dam makes it possible to provide weekly fluctuations of this amplitude without spilling any water.

Fig. 7. House mosquito-proofing is an important aid in preventing malaria transmission. The above view shows a well-built screened door and walls covered with kraft paper.

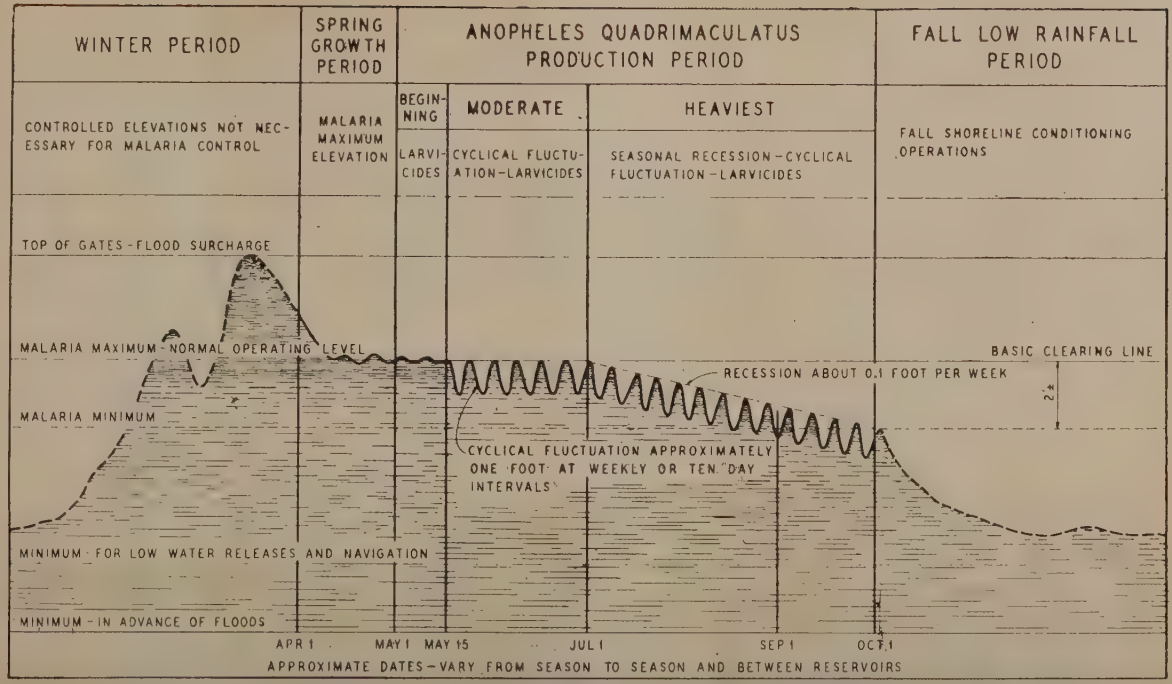


Fig. 8. Desirable features of water level management for malaria control onmain river reservoirs.

A. Water level at the normal maximum summertime elevation.

B. Water level drawn down one foot below the normal maximum summertime elevation.

Fig. 9. Cyclical fluctuation of water levels is an effective means of controlling production of **Anopheles quadrimaculatus.**

On the storage reservoirs, the water level management schedule is limited to seasonal recession alone. In the normal use of these reservoirs they are filled during the rainy spring period and gradually drawn down during the summer season. This gradual summer drawdown maintains a clean shoreline and thus provides satisfactory control. Serious production of **Anopheles**

quadrimaculatus on the storage reservoirs usually occurs only during abnormal periods of summer floods during which the water level is brought back up into the marginal vegetation.

Hess and Kiker (1943) have recently given a detailed review of the water level management schedules for malaria control on the Authority's reservoirs.

APPLICATION OF LARVICIDES

In developing its malaria control program, the Authority has attempted to make increased use of the more effective and less costly permanent and naturalistic methods of controlling **A. quadrimaculatus** and to decrease the use of larvicides; however, it is still necessary to provide for the application of larvicides as an emergency measure and for routine use in certain areas where other measures do not produce adequate control. The larvicides used are Paris green and oil. These are applied by means of airplane dusting, boat oiling and dusting, and hand oiling and dusting. For airplane dusting, the Paris green is diluted with soapstone at the rate of about 1:4. Less concentrated mixtures may be used for hand dusting. The larvicidal oil consists of a mixture of 9 parts kerosene to 1 part black oil. The black oil serves chiefly as a marker for gauging visually the concentration in the oil water stream.

Airplane dusting (See Fig. 10) is the most economical means of applying larvicides and is particularly applicable to extensive shallow areas which are inaccessible by boat and too large for hand treatment. Boat oiling (See Fig. 11) and dusting is generally used for the treatment of relatively narrow bands of vegetation along shorelines which are unsuitable for airplane dusting. Hand oiling and dusting is used for the treatment of small areas which

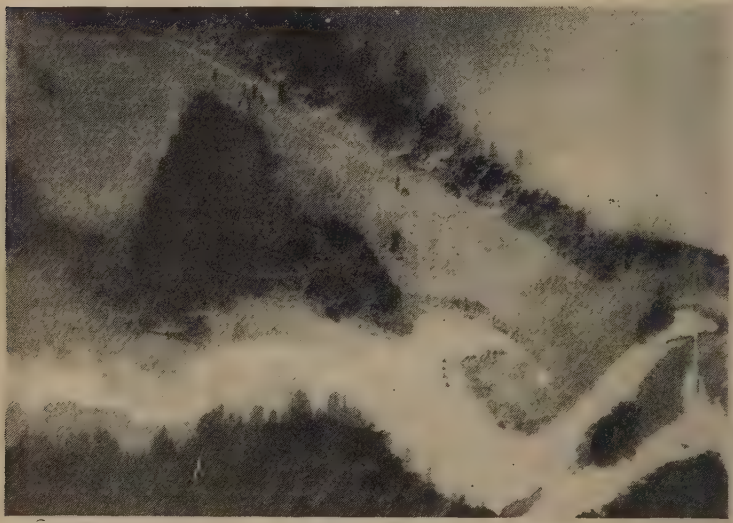


Fig. 10. On the cleared reservoirs of the Tennessee Valley Authority, airplane dusting is the most efficient means of applying anopheline larvicides to the larger breeding areas.

are inaccessible by boat and too small for airplane dusting.

Recent developments in the use of airplane dusting for malaria control have been discussed by Kruse, et al (1943).

SUMMARY

With the completion of the present construction program, the Tennessee Valley Authority will have in operation over twenty reservoirs with a total water surface of some three quarters of a million acres and a shoreline of over ten thousand miles. An appropriate program of malaria control is put into operation on each of the reservoirs where conditions are suitable for the production of sufficient numbers of **Anopheles quadrimaculatus** to create a malaria transmission hazard. This malaria control program is carried out in accordance with regulations of the health departments of the various states involved. The technical planning, supervision, appraisal, and development of the program is provided by a malaria control team consisting of a malariologist, biologist, and an engineer. Application of the program on individual reservoirs is under the direction of resident sanitary engineers. The main phases of the malaria control program are reservoir preparation, permanent shoreline improvement, shoreline maintenance, water level management, and the application of larvicides. Primary emphasis is placed upon the use of naturalistic measures, such as water level management and permanent shoreline improvement, in preference to artificial measures, such as the application of larvicides.

Fig. 11. Larvicidal oils are applied by boat to narrow bands of vegetation such as that shown in the above illustration.

NOTES and NEWS

PROGRESS IN MOSQUITO CONTROL IN UTAH

Organized mosquito control work is gradually being extended into other cities and counties in Utah as a result of civilian, army, state and federal public health agencies that have become aware of the mosquito problems existing in these areas.

A state law was passed in Utah in 1923 providing for the formation and operation of mosquito abatement districts in any part of the state, upon petition made to the Board of County Commissioners by registered voters equal in number to at least ten per cent of the number of votes cast in the proposed district for the office of governor at the election preceding the presentation of the petition.

Salt Lake City was organized as a district in 1924 and to date has operated as the only district in the state. During this period other cities and counties have considered the organization of districts but no legal action has been taken until recently.

During 1933-34, six counties in Utah carried on mosquito abatement projects with federal funds under C. W. A., F. E. R. A. and other agencies. Most of these funds were expended in Salt Lake County, the remainder in five other counties around the larger centers of population. Some work was continued in most of these counties as long as federal aid was available, but was discontinued in all counties except Salt Lake in about 1938, when federal funds ceased.

In 1943 officials at Ogden and Brigham City became alarmed over the possibility of a malaria epidemic occurring in these areas. These cities are a distance of 40 and 60 miles from Salt Lake respectively. At Ogden a large Internment Camp for war prisoners was established and numerous cases of malaria appeared among the prisoners. At Brigham malaria was common among the patients in Bushnell General Hospital.

A mosquito survey was conducted in Ogden in Weber County, also in Brigham and other parts of Box Elder County in early June 1943. The survey was made by the author and Lt. W. W. Sampson, entomologist of the Sanitary Corps of the Army. Conditions were such in each area that Anopheline control was recommended. Civilian authorities and Army officials did some Anopheline control work in and around Ogden and Brigham during the latter part of 1943.

In June of this year the U. S. Public Health Service placed L. E. Perry Assistant Sanitarian (R) in charge of malaria control in District No. 8. Headquarters for a mobile unit was established at Ogden. Dr. Whitney Young was appointed by the Public Health Service as supervisor of malaria control work in the Ogden and Brigham area and some very effective work has been accomplished.

During the season Box Elder County has completed the formal organization of a district, the second in Utah. This district comprises the entire county, but to begin with control work will be restricted to Brigham, Tremonton and a few other larger communities.

Citizens of Weber County which includes the city of Ogden are attempting at present to organize a similar district. The organization is being sponsored by a recently formed public health unit and success seems highly probable.

These new districts will concentrate first on Anopheline control but will gradually expand to include pest species.

DON M. REES.

FROM THE CITY OF NORFOLK, VIRGINIA

A certain ancient adage expresses the general idea that He Whom Fate Smiles Upon Is Beyond The Need of Great Riches.

I have always felt there was nothing that could quite take the place of a goodly sum in the savings bank when it comes to easing the aches and pains of our daily tussle with life but I must also admit that Fate can be a big help if she cares to hand you a lucky deal.

Last winter the temptation was strong on the part of many mosquito men to give way to a feeling of gloom when they tried to look around the corner toward the summer that was inevitably creeping up on their weakened defenses. Manpower and munitions were both scarce and replacements difficult to obtain. The prospects were not encouraging. But our fraternity is made up of fighters — or they would not be mosquito men — and there was no quitting on any front. From last reports the enemy is again taking a licking all along the line.

Such success can spring only from a combination of knowledge, energy and experience but now and then it is helped along a little by Fate — which is as good a name as any other for dry weather — and that is our case here in the Tidewater Virginia area. From late April until the middle of July, Norfolk experienced an unprecedented drought that reduced ground water to a minimum, nearly ruined the farmer and gave our pitifully meager army an even chance against the mosquito. We have accepted our good fortune gratefully and have employed every effort to make the best possible use of it. We intentionally refrain from anything that could be interpreted as bragging, for Fate's sunny smile often turns to a watery frown over night, but we are just as human as if we had office hours from ten to four and our feelings are hurt when we do not receive credit for what we have accomplished.

This situation is aptly covered by another old proverb somewhat to the effect that A Little Bit of Knowledge Is Likely To Make Trouble For Somebody and I wonder how many of us have been caught in the backfire of our own teaching. For years now we have been impressing our good friends with the fact that water is the only known medium in which mosquitoes can breed. After so long a time we realize that this message has begun to strike home. Our work has borne fruit and the truth has been heard. Now some of these same friends, armed with this Bit of Knowledge, eye the parched landscape and openly wonder if we really deserve the soft job we are enjoying during the drought. No water — no mosquitoes. Nothing for us to do but rest comfortably all day!

Dr. William B. Hermes in the latest edition of his Mosquito Control says, "Man by his works presents numerous opportunities for mosquito breeding, of which the mosquitoes take prompt advantage."

With all of us engaged in mosquito abatement, any statement by Dr. Hermes carries the authority of a top ranking expert in his field and it is obviously no coincidence that during the period from May 1 to July 15 our inspectors have brought to our field office no less than 383 individual samples of breeding taken from all over the city. These, of course, do not represent the total number of places treated to eliminate mosquito larvae since the time required to sample each catch basin visited, for instance, would be prohibitive but they do provide an index of the female mosquitoes' egg-laying urge that can be satisfied even when rainfall ceases to be a contributing

factor. They are of course almost exclusively the domestic species and consist largely of Culex Pipiens and Aedes Aegypti, the latter first appearing here this year in outdoor locations on June 8, rather earlier than usual. As a point of interest, our heaviest percentage of breeding in units inspected occurred in the fast disappearing but still worrisome watering troughs and these were followed by basements and then the garden fish ponds.

No, we cannot blame the layman for assuming that we and the mosquitoes have gone on a vacation during the drought. We have spent a good deal of effort in associating water and mosquitoes in his mind and it is not his fault that he does not know how to look for water that he cannot see. Perhaps for our own vindication and self-preservation we should carry our publicity a little further and get the rest of the story out in the open where it can save our reputation as well as lighten our task. We are working on that now.

PERRY W. RUTH, Chief,
Bureau of Mosquito Control,
Department of Public Works.

DELAWARE COUNTY, PENNSYLVANIA, MOSQUITO EXTERMINATION COMMISSION

At the request of the County Commissioners of Delaware County, Pennsylvania, Sanitary Engineer (R) Russell W. Gies of the United States Public Health Service, Office of Malaria Control in War areas, has been assigned as Acting Executive Officer of the Delaware County Mosquito Extermination Commission, as well as Director of Mosquito Control work in the City of Philadelphia. Major Gies has been assisting the City of Philadelphia since the beginning of the 1943 mosquito breeding season, working with the Philadelphia Department of Public Health and the Philadelphia Department of Public Works at the request of the Mayor of Philadelphia. His Philadelphia address is Room 616 City Hall Annex, and his Delaware County address is the Court House, Media, Pa.

The Philadelphia-Delaware County area covers the second largest War Industrial area in the United States with a total population of two and one-half million people. The large War Industries have had a considerable reduction in their War production output in past years on account of the excessive number of mosquitoes and it was to help in reducing the number of mosquitoes below the point at which they would adversely affect War production, that this co-operative effort between the Federal Government and the local authorities was undertaken. In addition, considerable numbers of Army and Navy personnel are being returned to Philadelphia for treatment from the tropics many of whom are malaria carriers. The Armed services are cooperating with the mosquito control work under Major Gies' direction by furnishing personnel to assist the inspection personnel of the City of Philadelphia and Delaware County in locating mosquito breeding areas, especially in the vicinity of the service Hospitals in the area. This co-operative effort is also providing an opportunity for field training of the Army and Navy personnel assigned for this co-operative work. The Malaria Control offices of the Philadelphia Naval Hospital especially are taking great interest in the work being carried on under the direct orders of the Commanding Officer of the Naval Hospital.

A number of unusual conditions in the Philadelphia-Delaware County area, which will be described more in detail in a later issue of Mosquito News, have contributed toward the large number of mosquitoes in this area. The work which is being carried on is beginning to get good results from most of the area, but considerably better results will be obtained as additional equipment and manpower is made available for doing this work. In Philadelphia Dr. Rufus Reeves, Director of Public Health, is taking much

interest in the work being done, which is handled through the Division of Housing and Sanitation, chief of which is Mr. Herbert M. Packer. The Department of Public Works, under Director John Neeson operates through the Highway Bureau through the Meadowbanks Division of the Highway Bureau under the direction of Mr. William Doherty, Principal Assistant Engineer of the Highway Bureau. In Delaware County, Mr. Clarence L. Conner, Chairman of the County Commissioners, is providing some prison labor due to the labor shortage for spraying and ditching. A co-operative Committee, representing the top management of the Westinghouse Electric and Manufacturing Company, Baldwin Locomotive Works, Sun Shipbuilding and Drydock Company and General Steel Castings Company has provided a great deal of help in carrying on the program. Dr. Robert M. Stabler, Assistant Executive Officers and Entomologist in Delaware County, is working on a full time basis during the summer and part time during the rest of the year while he is teaching at the University of Pennsylvania as Professor of Parasitology.

From MAJOR RUSSELL W. GIES.

—oOo—

A LETTER FROM NEW GUINEA

From Lieutenant Walter Abramitis to Major Russell W. Gies

24 June 1944
New Guinea
APO No. 713, c/o Postmaster
San Francisco.
ASN 0521028

Dear Major Gies:

It has been a long time between letters; however, now that we are more static, I thought I would write you.

By this time I have visited a number of places in New Guinea and at last look forward to staying longer. Packing and unpacking, waiting and travel is a hardship with plenty of rough living and poor food. People that try "C" rations once proclaim its goodness, but a steady diet of it proves otherwise. I'm still not used to eating hash, stew and beans for breakfast! Yet, I've had to eat it on many occasions. "C" rations, bully beef, dehydrated vegetables and canned fruit are the staples here. Whenever we get "fresh" meat or vegetables it is a rare treat. Dietitians who claim dehydrated foods will have a prominent place in the "food for tomorrow" are speaking through their hats -- only the destitute will even consider it.

Many erroneous ideas of the tropics have been disseminated by novels, articles and even explorers — Perhaps it is a jealousy to keep it sounding uninhabitable, mystic, etc. I have found the tropical climate very agreeable. The hot days are easily offset by the pleasantly cool nights that require a blanket or two to keep warm. When it rains it becomes cool also. We have about 190 inches of rain a year so that we do get rain. Much of it falls at night so that by morning it is nearly dry. Wild animals are not near as frequent in the jungles as one is led to believe. In four months, I've only come across two pythons, one 11 feet and the other 8 feet, wild pigs are common, birds rather abundant. However, many times I've tramped the jungles without running across anything significant.

Our present setup is almost ideal. We have wooden floors in our tents and a well constructed and screened-in laboratory in which to perform our work. Literature on Culicines has been scarce and for sometime not able to identify anything other than Anophelines. Fortunately the Aussies have helped us tremendously by giving us a Culicine larval key — it is a very good one at that.

We have been extremely busy in our work with which you are familiar. The days, weeks, and months fly by rapidly and I find it hard to do all I want working seven days a week. I have a few "pet" things I want to do such as repellent testing and insect collecting — if the opportunity presents itself. How are things with you? The Philadelphia Project? How is your new addition to the family? Do you know Dunning's address and Lang's? I've lost track of them and certainly would like to write them. I trust everything is going smoothly with you and that you are enjoying the best of health. Lest I forget to ask — is Major Chapman still at New Orleans?

Write when the opportunity presents itself.

Respectfully,

WALTER.

COPY of a letter received from Lieutenant Walter Abramitis, Sanitary Corps, now on duty in New Guinea. Lieut. Abramitis is a former graduate student of Dr. Headlee at Rutgers University, New Brunswick, N. J. and was on the staff of the survey in 1942 carried on by the U. S. Public Health Service in the Philadelphia area. He would be glad to get letters from anybody in the mosquito control work.

(Major) RUSSELL W. GIES.

* * *

Editor's Note: We are sure that many of the members and readers are receiving interesting letters from their friends in war areas. Such letters having been passed by the Censor, their publication should be permissible; and they would be of much interest to all of us. Copies of such letters appropriate for publication in Mosquito News should be sent to R. D. Glasgow, Editor Mosquito News, New York State Museum, Albany, New York.

—oOo—

LIEUTENANT COMMANDER A. A. WEATHERSBEE NOW STATIONED AT NORFOLK, VIRGINIA

Lt. Commander A. A. Weathersbee, formerly of the South Carolina State Board of Health, is now stationed in Norfolk in the Malaria Control unit of the Fifth Naval District. Dr. Weathersbee is being assisted by Lt. (jg) John Rayner, a graduate of the University of California and of Cornell.

From WILLIAM E. BICKLEY, Assistant Sanitarian,
U.S.P.H.S. Malaria Control in War Areas,
Norfolk, Va.

The following personnel are engaged in malaria control work for the U. S. Public Health Service, District No. 1, Malaria Control in War Areas Office:

Baker, W. C.
Barnes, R. C.
Berg, M.
Boyers, M.
Fellton, H. L.
Lang. S. L.
Lyman, F. E.
Matheson, R. (Special Consultant)
Riley, T. P.
Schneider, S.
Smith, R. E.
Sterenberg, L. A.
Thom, W. (Special Consultant)
Welsh, J. P.
Wilson, C. A.

The New England States, New York, Pennsylvania, New Jersey and Dela-

ware are covered by the above personnel, and the central office is located at 15 Pine Street, New York, New York.

In addition to the identification of mosquitoes collected by our own personnel, identification of material is being handled by this office for Army and Navy establishments as follows:

Second Service Command:
Larval and adult mosquitoes and light trap specimens.

Third Service Command:
Mosquito light trap specimens.

At the conclusion of the present mosquito breeding season, it is planned to publish a list of mosquito distributional records for the northeastern states. The extensive collecting being done in connection with the M. C. W. A. program and by Army and Navy personnel in the northeastern and middle Atlantic states should add to our knowledge of the occurrence and distribution of mosquitoes in this section of the United States.

CLIFTON A. WILSON,
Assistant Sanitarian (R).

24 July 1944

EDITORIAL SECTION

HOW SHOULD MOSQUITO NEWS BE REORGANIZED?

FOREWORD

Beginning with the first (March) number of the 1945 volume, it is planned to make substantial changes in the format and the coverage of Mosquito News, so that for its important and otherwise unoccupied field it may take its proper place among the best scientific and technical periodicals of its kind.

The Editor, as Chairman, would welcome for consideration by the Publication Committee, suggestions from members of the Association concerning details of all kinds which might make Mosquito News most useful to themselves and to the important public service they perform, or to the performance of which they may contribute.

Members of the Association, **Mosquito News** is your own official journal. What form do you wish it to be given; and what special services do you wish it to perform? Within available resources, your Committee will strive to make it as useful and as truly representative of your wishes as possible.

HISTORICAL NOTE

Mosquito News was started in March, 1941, by the then Eastern Association of Mosquito Control Workers.

The E.A.M.C.W. was organized in 1935 to meet as effectually and tactfully as possible, the irresponsible crusade against mosquito control work which was then being carried on as a campaign of "conservation" by a seemingly incongruous alliance between organized groups of gunners, and of uninformed and obviously misled, but enthusiastic amateur nature lovers.

The Association proved to be mutually advantageous, and was continued; and with the publication of Mosquito News, applications for membership began to come from other regional areas, until at the beginning of 1944 the following 31 states and territories, and 7 foreign countries were represented.

Foreign Countries Represented

Australia	Cuba	Venezuela
Canada	England	
Columbia, S. A.	Haiti	

States, Territories, etc. Represented

Alabama	Indiana	New York
Arkansas	Iowa	Ohio
California	Kansas	Oregon
Canal Zone	Louisiana	Pennsylvania
Connecticut	Massachusetts	Rhode Island
Delaware	Maryland	Tennessee
District of Columbia	Minnesota	Texas
Florida	Mississippi	Utah
Georgia	Missouri	Virginia
Hawaii	Montana	
Illinois	New Jersey	

Since the membership had thus become nation-wide, at the annual meeting in March, 1944, it was decided to reorganize the Association as the

American Mosquito Control Association, with Mosquito News continued as its official journal.

At that time, the first (March) number of volume 4 (1944) was off the press: so it was decided to complete volume 4 in its present form, but to reorganize Mosquito News beginning with the first (March) number of volume 5 (1945) in such a manner that it might take a place among scientific and technical journals, corresponding to the place of the National Association it represents among similar organizations.

Association Members' Preview
of
ITEMS FOR CONSIDERATION
at a
Meeting of the Mosquito News Publication Committee
To be held at ..... on .....

General Topics

A. Plans for the Future Form of Mosquito News.
B. Financial Ways and Means.
C. General Policies.

Basic Propositions

1. Income from advertising is necessary for maintenance of Mosquito News at maximum usefulness.

II. Substantial income from advertising will be forthcoming only if the numbers and the market quality of the member-subscriber-reader list should prove attractive to advertisers.

The narrower the range of interests represented by this list, the fewer will be the advertisers who might care to reach the limited market so represented, regardless of the numbers involved.

With a broader sense of more varied interests, and a sufficiently large member-subscriber-reader list, the potential market for the sale of advertising space would be correspondingly increased.

III. The probable maximum size of the membership list available to the American Mosquito Control Association, and of the subscriber-reader list available to Mosquito News, will depend upon the governing policies of the Association; upon the policies which will determine the scope of the interests to be served, and thus the diversity of market requirements and the aggregate numbers of interested individuals who may provide the base for any such member-subscriber-reader list.

Breakdown of Items for Consideration

A. Plans for the Future Form of Mosquito News.

1. The general "lay-out" must be made equal to the best.

2. The contents must be increased in scope, in volume, and in appropriate variety.

3. Tentative plan for **Contents** suggested as a basis for discussion:
Index to Advertisers.
Contents.
Special Articles.

Personal Notes and News.
Technical Notes and News.
Items and Events of Interest to Mosquito Control Workers.
Discussion (Members forum, Letters to the Editor, etc.)
Editorial Section.
Biographical Notes.
Obituaries.
Proceedings of the Association.
Proceedings of Regional Branches.
List of Members (In one number of each volume).
Book Reviews (Books of Interest to Mosquito Control Workers).
Abstracts (Of significant articles published elsewhere).
Bibliography (List of articles of interest to mosquito control workers).
Index to Mosquito Control Workers (In one number each year).
Index to Sources of Supplies (In each number) (Advertisers, and commercial subscribers to be indicated by special type).
Comments and additional suggestions are urgently requested.

4. Advertising pages to be numbered in Roman numerals: I, II, III, IV, V, —
5. Text pages to be numbered in Arabic numerals: 1, 2, 3, 4, —
6. Mosquito News must be made easier to read.
7. Larger type is imperative.
8. Readableness can be secured:
   (a) By more open (leaded) spacing of type.
   (b) By shorter lines (by a two column page).
9. A two column page would require a larger page size.
10. The two column page is said to be the most economical to publish, as well as the easiest to read.
11. Galley proof must go to contributors as in standard publication routine.
12. Reprints must be made available to contributors at least at reasonable rates.

Comparisons

Mosquito News, is now a small octavo in size, with a one column page, printed in 8 point type not leaded. **Is very difficult to read,** because of the long line of compactly set small type.

Journal of the National Malaria Society, is a standard octavo in size, with a one column page, printed in 12 point type, not leaded. **Is very easy to read,** because of the exceptionally large type.

Proceedings of the New Jersey Mosquito Extermination Association, is a standard octavo, with a one column page, printed in 10 point type not leaded. **Is difficult to read,** because of the long line of compactly set type.

Journal of Parasitology, is a large octavo, with a one column page, printed in 10 point type leaded with a 2 point lead, and in 8 point type leaded with a 1 point lead (or with type bodies correspondingly larger than the type face). **The former is not too difficult to read;** but **the latter is very difficult** to read, because of the long lines.

American Journal of Public Health, is a large octavo, with a two column page, printed in 10 point type with a 1 point lead (or with the type body correspondingly larger than the type face). **Is very easy to read,** because of the short line, and the open, large type used.

Ecology, is a large octavo, with a two column page, printed in 10 point type with a 1 point lead (or an equivalent ratio between type body and type face). **Is very easy to read** because of the short line, and the open, large type used.

Journal of Economic Entomology, is a large octavo, with a two column page, printed in 10 point type, not leaded, and in 8 point type not leaded. **Is easy to read** because of the short lines, in spite of the compactly set type.

Best Patterns for Consideration

1. **The Journal of the National Malaria Society** (published only once a year, however) is outstanding for large type readableness; but **probably too expensive.**

2. **The American Journal of Public Health**; admirable, perhaps possible, but not the most economical.

3. **Ecology**; admirable, and almost exactly like the American Journal of Public Health.

4. **Journal of Economic Entomology**; still very good indeed, and the most economical form of publication among the four suggested models.

B. Financial Ways and Means.

1. Drive for increased income from advertising.
   (a) Must qualify by becoming able to guarantee an attractive minimum of appropriate circulation.
   (b) This may be accomplished by a successful drive for increased membership in the Association.

C. General Policies.

Several members have expressed the opinion that the A.M.C.A., and Mosquito News should be limited in scope rather narrowly to the field of actual mosquito control work.

This raises several questions:

1. Thus narrowly restricted,

   (a) Would the so limited range of market interests, and the probable maximum available member-subscriber-reader list, and consequent circulation, be sufficient to assure adequate supplementary support from the sale of advertising space that would be necessary to publish the standard technical periodical without which the Association probably could not long be held together?

   (b) Is the narrowly limited field of "practical" mosquito control work a logical technical, or administrative unit?
      (1) The mosquito abatement laws of several states expressly include "mosquitoes, and/or ---" various other homonoxious arthropods.
      (2) Control of such other homonoxious Arthropods will eventually be demanded; and responsibility for their control must be assumed by existing Mosquito Abatement Commissions, or other agencies competing for funds will be set up to do the work, with the corresponding wastefulness of multiplied overhead expense.
      (3) "Practical" mosquito control work in any sense is merely applied Medical Entomology within a special field.

> Both the "practical" mosquito control worker and other specialists in the related sub-divisions of Medical, and Sanitary, and Entomological Engineering and Research are concerned with promoting an orderly increase all along the line in our knowledge of mosquitoes and similar homonoxious arthropods; of their interrelations with man, with other living things, and with the physical environment; and of ways and means by which these interrelations may be modified in such a manner that some grave insect menace may be suppressed, and that the resulting benefit may sufficiently outweigh any attendant resulting disadvantage.

The greatest good of all workers in these related fields, both contributing and applied, and of the public and the scientific disciplines they serve, would seem to be most effectually advanced by promoting the most frequently practicable interchange of information and ideas. To do his best work the "practical" mosquito control worker must keep informed about recent advances in related fields that may contribute to his efficiency; and the worker in related fields in turn should know the problems that call for further work, and the conditions which must govern the practical application of his findings.

At present there appears to be no single medium nor any conveniently usable alternative for bringing about such a desirable interchange of ideas and information among these groups of workers.

The American Mosquito Control Association through Mosquito News, freed from illogical restraints, and soundly developed, would seem to have most promise of providing such a medium.

The broader base so established should, in turn, provide a diversity of market interests and requirements, and an aggregate potential member-subscriber-reader list unquestionably sufficient to assure the circulation necessary to attract substantial support from the sale of advertising space adequate to maintain a standard periodical in this field.

A standard periodical in this field, also, should become an attractive medium for the publication of appropriate manuscript.

A soundly reorganized Mosquito News has a future.

Be sure, as soon as possible, to let us have your comments and suggestions. R. D. G.

REVIEWS AND ABSTRACTS

Editor's Note: In addition to Mr. Harry H. Stage's invaluable Bibliography ("References to Literature of Interest to Mosquito Control Workers"), Mosquito News will try the experiment of adding a section for **Reviews and Abstracts**, of books, and of articles published elsewhere that may be of special interest to mosquito control workers. To be successful, this new section must have the cooperation of members and readers everywhere. Members should prepare for publication in Mosquito News and send to the Editor, a brief abstract of any article they may have had accepted for publication elsewhere; members should suggest to the Editor, books and articles which in their judgment should be reviewed or of which abstracts should be prepared; and last, but by no means least, it is hoped that members themselves, where possible, will prepare and submit for publication in Mosquito News, signed reviews and abstracts of significant books and articles that may come to their attention.

* * *

Saboteur Mosquitoes. By Harry H. Stage, Senior Entomologist, U. S. Bureau of Entomology and Plant Quarantine, National Geographic Magazine, 85 (Feb. 1944): 165-179, 12 figures; and **Life Story of the Mosquito** by Graham Fairchild, formerly Medical Entomologist, Gorgas Memorial Laboratory, Panama; now First Lieutenant, Sanitary Corps, Army of the United States, working on new insect repellents and insecticides. National Geographic Magazine 85 (Feb. 1944): 180-195, 6 figures and 8 plates reproduced in color from paintings by the Japanese artist, H———— M————, and verified for accuracy by Dr. Alan Stone, Entomologist, U. S. Bureau of Entomology and Plant Quarantine.

No Fooling!

"An' the Gobble-uns 'll git you
Ef you
Don't
Watch
Out!"

In the February, 1944 number of the National Geographic Magazine are these two outstanding popular articles on mosquitoes and the part they have played, are playing now, and will continue to play in the affairs of men, unless prevented by intelligent and persistent application of our only recently acquired and still growing knowledge of these pernicious insects and of their importance in human ecology as critically active agents in a notable aggregate of profoundly important environmental hazards.

In **Saboteur Mosquitoes**, profusely illustrated with significant photographs reproduced in black and white, Mr. Stage tells how throughout recorded history military campaigns, the course of victory, and even the fate of nations have been decided by the intervention of mosquitoes.

Mosquito borne malaria shattered the health of Julius Caesar's whole army during the Roman civil wars; Napoleon's forces were ravaged by malaria; malaria was rampant during the Chino-Japanese war of 1894-95; this mosquito borne disease was responsible for more than 5,000 deaths during the Spanish-American war of 1898; and the British, French and German troops alike were immobilized for months by malaria in Macedonia during the first world war.

Neither Julius Caesar nor Napoleon knew that without mosquitoes there could be no malaria. In fact, no one knew that malaria is dependent on mosquitoes before 1898 (well within the memory of many men still living), when the work of Ross, Grassi, Bastianelli, Bignami, Celli, Manson and others proved that **Anopheles** mosquitoes are the carriers of this disease.

From time immemorial, malaria has been associated with swamps and marshes; and even after 1898 it was thought that swamp breeding mosquitoes were responsible. In general, marshy areas were malarious, and the upland relatively free from the disease. But in the Macedonian campaign of 1916 to 1918, and again when the Italians invaded Albania in 1939, as well as in the experience of our own troops in the Philippines, it has been learned at heavy cost that dangerous malaria carrying mosquitoes may inhabit

the hilly upland as well:—**Anopheles superpictus** in Europe, and **Anopheles minimus** in the Philippines.

Little was known about the life history and habits of mosquitoes prior to 1879 when Sir Patrick Manson showed that **Filaria bancrofti**, the blood inhabiting worm that is the cause of elephantiasis in man, passes through an intermediate development cycle in the body of a mosquito, after which the mosquito may transmit the worm parasite again to man.

Manson's discovery in 1879, supplemented by the discoveries at the turn of the century, that Anopheline mosquitoes are carriers of malaria, and that **Aedes aegypti** is a carrier of yellow fever, focused attention upon the importance of developing effective mosquito control procedures.

Beginning with the use of kerosene as suggested in 1892 by Dr. L. O. Howard, for many years Chief of the U. S. Bureau of Entomology, Mr. Stage traces the progressive suppression of mosquitoes and mosquito borne diseases up to the recent demand of the Surgeon General's Office for a larvacide which would kill malaria carrying mosquitoe larvae for several weeks after it has been applied to breeding places. "Such a larvacide must still be afloat after being subjected to torrential rains." Mr. Stage implies that this has already been accomplished, and that "This material, also, can be used effectively against adult mosquitoes."

Mr. Stage describes vividly how an African mosquito, **Anopheles gambiae** "known to be one of the most efficient and dangerous malaria vectors in the world" invaded northeastern Brazil, where it was first discovered in Natal in 1930; how this mosquito was responsible for 14,000 deaths in 1938 and 1939; and how the Brazilian Government aided by the Rockefeller Foundation had exterminated it by September 1940:—"A classic demonstration of species sanitation in mosquito control."

Mr. Stage describes the search for an efficient mosquito repellent, which produced the Formula 612, the dimethyl phthalate, and the indalone repellents which singly and in combination have been employed by the army in war areas. He also describes the aerosol "bomb" or "fine fog spray", which "may save more American lives than any other single invention of the war."

This article also tells of the relation of mosquitoes to the group of virus diseases which are called encephalitis or sleeping sickness in man, encephalomyelitis or brain fever in horses, and which may attack birds and many other animals.

In his beautifully illustrated companion article, Dr. Fairchild begins by describing his own personal experience with larvae of the human bot fly, that attaches its own eggs to the body of a mosquito, which then may bring the eggs and the larvae hatching from them into contact with an involuntary human "donor" from which the mosquito carrier may take a meal of blood.

As indicated by the title of his paper, Dr. Fairchild then describes the feeding habits, the egg laying habits, and the habits of the larvae and pupae of tropical mosquitoes, the life histories of which are illustrated by eight beautiful plates reproduced in color from paintings made exclusively for the National Geographic Magazine by the Japanese artist Hashime Murayama, and checked for accuracy by Dr. Alan Stone of the U. S. Department of Agriculture Bureau of Entomology and Plant Quarantine.

Dr. Fairchild then discusses the relation of mosquitoes to yellow fever, a subject to which he has himself made notable contributions, as well as the relation of these insects to other mosquito borne diseases.

He also tells how the eggs of northern mosquitoes may have to be refrigerated, as by a winter's cold, before they will hatch; and how the eggs of desert mosquitoes do not all hatch with the first fall of rain, which might be disastrous for the species if all hatched at once when too little water had fallen to complete their development. Indeed, the eggs of some of these "dry-land" mosquitoes may remain alive for at least five years, if conditions are not right for hatching.

Mosquito control workers might well bring these two articles to the attention of their public. If copies of this issue of the National Geographic Magazine are not available for purchase, the articles may be read in public libraries everywhere.

Mosquito Control, by William Broadbeck Herms and Harold Farnsworth Gray. 1944, Second Edition, Revised and Enlarged. XIV + 419 pages, with 9 tables, 11 plates, and 86 figures. Published by the Commonwealth Fund, New York, and Humphrey Milford, Oxford University Press, London.

The editor has just seen a copy of this indispensable book; which, unfortunately, came to hand too late for review in this issue of Mosquito News. The book will be reviewed in the December issue; but it is imperative that it be mentioned here, because it will be a "must" for mosquito control workers everywhere.

Mosquito Vectors and Inapparent Animal Reservoirs of St. Louis and Western Equine Encephalitis Viruses, by Hammon, W. McD., W. C. Reeves, and M. Gray. (Univ. of Cal., San Francisco) Amer. Journ. Publ. Health, 33 (3): 201-207, 1943.

In this report read before the Health Officers Section of the American Public Health Association at the Seventy-first Annual Meeting at St. Louis, Mo., October 28, 1942, the authors review and discuss some recent findings in their own work and that of others on the epidemiology of the St. Louis type of encephalitis. The St. Louis epidemic of 1933 was characterized as up to that time the largest localized encephalitis epidemic ever recognized to have occurred in North America. And only one other epidemic has surpassed it in numbers of cases and deaths—that of the western type in and about North Dakota in 1941. Since the virus of western equine encephalomyelitis is responsible for an epidemic infection of man epidemologically closely parallel to that produced by the St. Louis virus, the two were discussed together with emphasis on the St. Louis type.

In the 1933 epidemic, transmission by mosquitoes was suggested, but not proved. Mosquito transmission in the laboratory was attempted at that time, but failed. In the years following the St. Louis epidemic, it has been shown that, following inoculation, the St. Louis virus may be found readily in the blood of chickens, ducks, doves, horses, mice, monkeys, guinea pigs and rabbits.

Substances (antibodies) that neutralize the St. Louis virus have been found in the blood serum of normal persons as well as of those convalescent from encephalitis in many parts of the United States. Antibodies have been found in the serum of horses and of numerous other vertebrates, both domestic and wild.

In a closely correlated series of field and laboratory studies sponsored by the George Williams Hooper Foundation for Medical Research, University of California, San Francisco, California, and the Washington State and Yakima City-County Health Department, aided by a grant from the National Foundation for Infantile Paralysis, Inc., the authors report that the St. Louis and the western equine virus were isolated repeatedly from one species of mosquito, **Culex tarsalis** Coquillett, and that antibodies to both viruses were found in as high as 50 per cent of apparently healthy domestic fowl in that area. These findings suggested both mosquito transmission, and a large "inapparent" vertebrate reservoir as a source of infection.

The authors cite the claim of Mitamura and associates in Japan of successful transmission of the St. Louis virus by **Culex pipiens variety pallens**, Coq., subsequently disputed, but recently confirmed by the authors with transmission by **Culex pipiens** Linn. to doves, mice and pigeons. The authors cite also, the extensive successful transmission of the western and eastern equine viruses by Aedine mosquitoes, by the wood tick, by a cone nose bug, all of which have been shown to be potential vectors. Epidemologically, however, the Aedine mosquitoes are considered the most likely vectors.

From the Yakima Valley studies, the finding of antibodies in many animals in the epidemic area and the isolation of virus from wild mosquitoes which feed upon these animals, appear to justify the hypothesis for both viruses of a mosquito-vertebrate-mosquito cycle. "It seems likely that mosquitoes become infected principally from animals which fulfill the following criteria: (1) they should be abundant; (2) they should show no apparent signs of infection, because no epizootic had ever been observed, except in horses and horses are relatively few in number; (3) they should have as a result of a small peripheral inoculation a reasonably large amount of virus circulating in the blood for more than a fleeting period of time; (4) it should theoretically be a bird because in an area where epidemics occur annually, the reservoir animal should be one which does not bestow a first season's protection to its offspring by maternal transmission of antibodies, as frequently occurs in mammals. --- For the Yakima area, young domestic fowl best fit all the above criteria of this hypothetical reservoir.

"Since all known vertebrate infections have been of short duration and laboratory mosquito infections have been occasionally lifelong, a mosquito which winters in the adult stage, such as **Culex tarsalis** in some areas, might be advanced as a hypothetical vector for the Yakima area. It is found frequently in domestic habitats, feeds readily on domestic fowl, and was found infected in nature."

Rigorously critical field collections, laboratory tests, and experimental studies are reviewed and discussed, leading to the following conclusions:

"Thus for both the St. Louis virus and the western equine virus the cycle suspected in nature has been reproduced. Since both the fowls and the mosquitoes used are present in large numbers in the epidemic area investigated, and have been demonstrated to be naturally infected, it seems reasonable to conclude that this cycle is a normal and an important one. Man, in contrast to the enormous number of other animals suffering from inapparent infection, appears to be an accidental host.

"Caution in generalization is advised."

Editor's note: Control of potential mosquito vectors is indicated, and possibly also of the tick reservoir suggested by the work of Blattner and Hays if confirmed.

Blood-Sucking Vectors of Encephalitis: Experimental Transmission to White Swiss Mice by the American Dog Tick, Dermacentor variabilis Say., by Blattner, Russell J. (Washington U. Sch. Med.) and Florence M. Hays (Children's Hospital, St. Louis, Mo.) Journ. Exp. Med., 79 (4): 439-454, 1 fig. 1944.

The common dog tick, **D. variabilis,** is shown experimentally to be capable of becoming infected by the virus of the St. Louis encephalitis, Hubbard strain, through feeding on inoculated laboratory animals, and of transmitting the virus to normal susceptible animals by its "bite". A female tick can transmit the virus to her young, through all stages of the second generation and on to the third generation without reinfection. Ticks infected under laboratory conditions and kept inactive at a temperature of 12.5° C. remained infective for at least 10 months. Eggs deposited by an infected female retained infective virus after storage in a refrigerator at 12.5° C. for 10 months, and larvae hatched from such eggs after 10 months dormancy were also infective.

The work reported is especially significant, since it is said to represent the first successful transmission of St. Louis encephalitis to experimental animals by a blood sucking vector. It is not claimed that the dog tick is the vector responsible for the transmission of St. Louis encephalitis virus to man, since no history of tick bite appears to have been recorded for any human case of St. Louis encephalitis. It is suggested, however, that tick populations may play an important role in the natural epidemiology of the disease by their ability to carry the virus from generation to generation. Possibly ticks feeding on birds and on other mammals may create foci from which the virus may be carried to human beings by some other blood sucking vector such as the mosquito.

Editor's note: This very interesting and significant investigation illustrates how previously unsuspected ecological interactions may complicate our present ideas concerning the control of mosquito borne diseases. The study here reviewed may indicate that in some areas tick eradication (to contribute toward control of encephalitis as well as of spotted fever) could become as much of an objective as mosquito control; and the local mosquito control agencies (if any) should logically head up such work.

Studies on the Transmission of the Western Srtain of Equine Encephalomyelitis by the American Dog Tick, Dermacentor Variabilis Say., and by Triatonea Sanguisuga Le Conte, by Grundman, A. W., Kitselman, C. M. Roderick, L. M., and Smith, R. C. (Kas. Agr. Exp. Sta. Manhattan) Journ. Infect. Dis. 72(2): 163-171. 1943.

The results of further work by these authors on the possible relationship between certain bloodsucking arthropods of the Great Plains region of the United States to the epidemiology of equine encephalomyelitis, indicate that the American wood tick, **Dermacentor variabilis** did not become infected with the western strain of equine encephalomyelitis through feeding on an infected animal. In no case was the virus demonstrable in recently molted ticks of the several stages which had engorged on infected animals prior to the molt. Also, the virus was not found to pass through the egg to the succeeding generation of larval ticks. The virus of the western strain of equine encephalomyelitis was successfully transmitted from guinea pig to guinea pig through the feeding of the "big bedbug", **Triatoma (Conorhinus) sanguisuga,** although the mechanism of transmission is not clear. Several strains of virus were isolated from collected triatomas of which one was identified as the western strain.

(The Dog Heartworm) Experimental Studies on the Larval Development of Dirofilaria Immitis in Certain Insects, by Summers, Wm. A. (Tulane Univ., New Orleans.) Amer. Journ. Hygiene, 37 (2): 173-178. 1943.

The author reports comparative tests on the susceptibility to infection with D. immitis of 10 species of mosquitoes and 3 species of fleas. In these tests, both laboratory reared, and wild caught mosquitoes were used. Of the 10 mosquito species tested, only 4 appear to be potential transmitters of the dog heartworm, and are grouped as follows according to the success with which the larvae of D. immitis were able to establish themselves: (1) Species which usually refused to take a blood meal when offered are **Culex apicalis** and **C. fatigans;** (2) Species which fed on the infected dog, but in which larvae failed to develop, **C. fatigans, C. salinarius, Aedes aegypti, A. vexans,** and **Psorophora postica;** (3) Species in which larvae developed, but with notable retardation, **C. territans;** (4) Species in which larvae developed without retardation, and with some damage to the mosquito host, **Aedes infirmatus, A. sollicitans,** and **Anopheles crucians.** The 3 flea species studied are **Ctenocephalides canis, C. felis,** and **Pulex irritans.** These appear to acquire infection in nature as well as under experimental conditions. The fleas, therefore, may be more responsible for maintaining a high rate of heartworm infection in dogs than has been generally supposed.

The Indian Rat Flea in Indiana, by Cable, R. M. (Purdue Univ.) Proc. Indiana Acad. Sci., 52: 201-202, 1943.

Reports that this oriental rat flea, chief carrier of plague in its homeland, has frequently been found on wild rats in the Lafayette area, and that in 1941 it even invaded colonies of white rats at Purdue University.

Editor's note: The inland spread of the plague bacillus in rodent populations, and of this carrier flea redirects attention to the fact that in the event of an outbreak of plague, mosquito control commissions and engineers, where established, would be logical agencies to head up the necessary rodent control and rat proofing operations; and that public interest might be best served by anticipating the possibility of such an outbreak through education of the public to demand and pay for suppression of the destructive potential reservoir of the plague bacillus through practical rodent sanitation.

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